This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

Claim 1 (currently amended): A method for producing three-dimensional information of an object ~~(4)~~ in medical X-ray imaging, characterized in that

- the object is modelled mathematically independently of X-ray imaging,
- the object is X-radiated from at least two different directions and the said X-radiation is detected to form projection data of the object ~~(4)~~,
- ~~and~~ said projection data and said mathematical modelling of the object are utilized in Bayesian inversion based on Bayes' formula

$$p(x \mid m) = \frac{p_{pr}(x)\, p(m \mid x)}{p(m)}$$

~~to produce three-dimensional information of the object,~~ the prior distribution $p_{pr}(x)$ representing mathematical modelling of the object, x representing the object image vector, which comprises values of the X-ray attenuation coefficient inside the object, m representing projection data, the likelihood distribution $p(m|x)$ representing the X-radiation attenuation model between the object image vector x and projection data m, p(m) being a normalization constant and the posteriori distribution $p(x|m)$ representing the three-dimensional information of the object ~~(4)~~, and

- three-dimensional medical X-ray imaging information of the object is produced.

Claim 2 (currently amended): A method according to claim 1, characterized in that the three-dimensional information of the object ~~(4)~~ is one or more two-dimensional images representing X-ray attenuation coefficient along slices through the object.

Claim 3 (currently amended): A method according to claim 1, characterized in that the three-dimensional information of the object ~~(4)~~ is a three-dimensional voxel representation of the X-ray attenuation in the object.

Claim 4 (currently amended): A method according to claim 1, characterized in that ~~the~~ a measurement model is m = Ax+e, where matrix A contains the lengths of the path of the X-ray

inside each voxel and the noise e is independent of object image vector x leading to the likelihood distribution

$$p(m \mid x) = p_{noise}(m - Ax).$$

Claim 5 (currently amended): A method according to claim 1, characterized in that the said mathematical modelling ~~comprises~~ employs the fact that X-radiation attenuates when passing through the object ~~(4)~~, which means that every image voxel is nonnegative.

Claim 6 (original): A method according to claim 1, characterized in that mathematical modelling is expressed by the formula:

$$p_{pr}(x) \exp(-\alpha \sum_N U_N(x))$$

where the sum is taken over a collection of 3D neighbourhoods N and the value $U_N(x)$ depends only on the values of voxels belonging to the neighborhood N, and α is a positive regularization parameter used to tune the width of the prior distribution.

Claim 7 (currently amended): A method according to claim 1, characterized in that ~~the~~ a 3D tomographic problem is divided into a stack of 2D tomographic problems and ~~on~~ in every such 2D problem, the mathematical modelling is expressed by the formula:

$$p_{pr}(x) \exp(-\alpha \sum_N U_N(x))$$

where the sum is taken over a collection of 2D neighbourhoods N and the value $U_N(x)$ depends only on the values of pixels belonging to the neighborhood N, and α is a positive regularization parameter used to tune the width of the prior distribution, and the 2D tomographic problems are related to each other by the formula

$$pr3D(x(j)) = \exp(-\gamma \sum\sum | x(j)[k,q] - x(j-1)[k,q] |),$$

where the sums are taken over all pixels (k=1,...,K, q=1,...,Q) and $\gamma > 0$ is another regularization parameter.

Claim 8 (currently amended): A method according to claim 7, characterized in that the neighborhoods ~~consist of~~ comprise two adjacent pixels and U calculates a power of the absolute value of the difference, leading to the formula

$$p_{pr}(x^{(J)}) = \exp\Big(-\alpha(\sum_{k=1}^{K-1}\sum_{q=1}^{Q}\left|x^{(j)}[k,q]-x^{(j)}[k+1,q]\right|^{s} + \\ +(\sum_{k=1}^{K}\sum_{q=1}^{Q}\left|x^{(j)}[k,q]-x^{(j)}[k+q,q]\right|^{8})\Big)$$

where s is a positive real number.

Claim 9 (currently amended): A method according to claim 8, characterized in that s=1 ~~corresponding~~ which corresponds to total variation (TV) distribution for prior describing objects ~~(4)~~ ~~consisting~~ comprised of different regions with well-defined boundaries.

Claim 10 (currently amended): A method according to claim 1, characterized in that mathematical modelling is qualitative structural information of the target where the structural information is encoded in prior distributions that are concentrated around object image vectors x that correspond to the physiological structures of the object ~~(4)~~.

Claim 11 (currently amended): A method according to claim 1, characterized in that the mathematical modelling ~~consists of~~ comprises a list or probability distribution of possible attenuation coefficient values in the object ~~(4)~~.

Claim 12 (original): A method according to claim 1, characterized in that the X-ray imaging geometry, such as X-ray source position, has unknown error modelled in the distribution p(m|x).

Claim 13 (original): A method according to claim 1, characterized in that the X-radiation measurement noise is Poisson distributed.

Claim 14 (original): A method according to claim 1, characterized in that the medical X-ray imaging is dental radiography.

Claim 15 (original): A method according to claim 1, characterized in that the medical X-ray imaging is surgical C-arm imaging.

Claim 16 (original): A method according to claim 1, characterized in that the medical X-ray imaging is mammography.

Claim 17 (currently amended): A method according to claim 1, characterized in that three-dimensional information of the object ~~(4)~~ is produced on the basis of ~~the~~ a maximum a posteriori estimator (MAP) which is calculated by the equation:

$$p(x_{MAP}\ m) = \max p(x|m)$$

m representing projection data and x representing the object image vector and where the maximum on the right hand side of the equation is taken over all x.

Claim 18 (currently amended): A method according to claim 1, characterized in that three-dimensional information of the object ~~(4)~~ is produced on the basis of ~~the~~ a conditional mean estimator (CM), which is calculated by the equation:

$$x_{CM} = \int xp(x\ m)\,dx$$

where m represents projection data and x represents the object image vector.

Claim 19 (currently amended): A medical X-ray device ~~(5)~~ arrangement for producing three-dimensional information of an object ~~(4)~~ in a medical X-ray imaging, characterized in that the medical X-ray device ~~(5)~~ arrangement comprises:

- means ~~(15)~~ for modelling the object ~~(4)~~ mathematically independently of X-ray imaging
- an X-ray source ~~(2)~~ for X-radiating the object from at least two different directions
- a detector ~~(6)~~ for detecting the X-radiation to form projection data of the object ~~(4)~~
- ~~and~~ means ~~(15)~~ for utilizing said projection data and said mathematical modelling of the object in Bayesian inversion based on Bayes' formula

$$p(x \mid m) = \frac{p_{pr}(x)p(m \mid x)}{p(m)}$$

~~to produce three-dimensional information of the object,~~ the prior distribution $p_{pr}(x)$ representing mathematical modelling of the object, x representing the object image vector, which comprises values of the X-ray attenuation coefficient inside the object, m representing projection data, the likelihood distribution $p(m|x)$ representing the X-radiation attenuation model between the object image vector x and projection data m, $p(m)$ being a normalization constant and the posteriori distribution $p(x|m)$ representing the three-dimensional information of the object ~~(4)~~, and

- means for producing three-dimensional medical X-ray imaging information of the object.

Claim 20 (currently amended): A medical x-ray device ~~(5)~~ arrangement according to claim 19, characterized in that the three-dimensional information of the object ~~(4)~~ is one or more two-dimensional images representing X-ray attenuation coefficient along slices through the object.

Claim 21 (currently amended): A medical x-ray device ~~(5)~~ arrangement according to claim 19, characterized in that said medical X-ray imaging means for producing three-dimensional information produces ~~the~~ three-dimensional information of the object ~~(4)~~ that is a three-dimensional voxel representation of the X-ray attenuation in the object.

Claim 22 (currently amended): A medical X-ray device ~~(5)~~ arrangement according to claim 19, characterized in that the medical X-ray device arrangement comprises means ~~(15)~~ for modelling ~~the~~ a measurement as

m = Ax+e,

where matrix A contains the lengths of the path of the X-ray inside each voxel and the noise e is independent of object image vector x leading to the likelihood distribution

$$p(m \mid x) = p_{noise}(m - Ax).$$

Claim 23 (currently amended): A medical X-ray device ~~(5)~~ arrangement according to claim 19 characterized in that the medical X-ray device arrangement comprises means ~~(15)~~ for modelling the object ~~(4)~~ mathematically so that X-radiation attenuates when passing through the object ~~(4)~~, which means that every image voxel is nonnegative.

Claim 24 (currently amended): A medical X-ray device ~~(5)~~ arrangement according to claim 19, characterized in that the medical X-ray device arrangement comprises means ~~(15)~~ for modelling the object ~~(4)~~ mathematically by the formula:

$$p_{pr}(x) = \exp(-\alpha \sum_N U_N(x))$$

where the sum is taken over a collection of 3D neighbourhoods N and the value $U_N(x)$ depends only on the values of voxels belonging to the neighborhood N, and α is a positive regularization parameter used to tune the width of the prior distribution.

Claim 25 (currently amended): A medical x-ray device ~~(5)~~ arrangement according to claim 19, characterized in that ~~the~~ a 3D tomographic problem is divided into a stack of 2D tomographic problems, and ~~on~~ for every such 2D problem, ~~and~~ the medical X-ray device arrangement comprises means ~~(15)~~ for modelling the object ~~(4)~~ mathematically by the formula:

$$p_{pr}(x)=\exp(-\alpha\sum_{N}U_N(x))$$

where the sum is taken over a collection of 2D neighbourhoods N and the value $U_N(x)$ depends only on the values of pixels belonging to the neighborhood N, and α is a positive regularization parameter used to tune the width of the prior distribution, and the 2D tomographic problems are related to each other by the formula

pr3D(x(j)) = exp(- γ ΣΣ | x(j)[k,q] - x(j-1)[k,q] |),

where the sums are taken over all pixels (k=1,...,K, q=1,...,Q) and γ > 0 is another regularization parameter.

Claim 26 (currently amended): A medical X-ray device ~~(5)~~ arrangement according to claim 25, characterized in that the ~~neighborhood systems consist of~~ neighborhoods comprise two neighboring pixels xj, xk or voxels xj, xk and $U_N(x)$ calculates a power of the

$$p_{pr}(x^{(J)})=\exp\Big(-\alpha(\sum_{k=1}^{K-1}\sum_{q=1}^{Q}\left|x^{(j)}[k,q]-x^{(j)}[k+1,q]\right|^{s}+ \\ +(\sum_{k=1}^{K}\sum_{q=1}^{Q}\left|x^{(j)}[k,q]-x^{(j)}[k+q,q]\right|^{8})\Big)$$

absolute value of the difference, leading to the formula where s is a positive real number and α is a regularization parameter used to tune the width of the prior distribution.

Claim 27 (currently amended): A medical X-ray device ~~(5)~~ arrangement according to claim 26, characterized in that the medical X-ray device arrangement comprises means ~~(15)~~ for modelling the object ~~(4)~~ mathematically by setting s=1 corresponding to total variation (TV) distribution for prior describing objects ~~consisting of~~ comprising different regions with well-defined boundaries.

Claim 28 (currently amended): A medical X-ray device ~~(5)~~ arrangement according to claim 19, characterized in that the medical X-ray device arrangement comprises means ~~(15)~~ for modelling the object ~~(4)~~ mathematically by assuming that mathematical modelling is qualitative structural information of the target where the structural information is encoded in prior distributions that are concentrated around image vectors x that correspond to the physiological structures of the target.

Claim 29 (currently amended): A medical X-ray device ~~(5)~~ arrangement according to claim 19, characterized in that the medical X-ray device arrangement comprises means ~~(15)~~ for modelling the object ~~(4)~~ mathematically by assuming that mathematical modelling ~~consists of~~ comprises a list of possible attenuation coefficient values in the object.

Claim 30 (currently amended): A medical X-ray device ~~(5)~~ arrangement according to claim 19, characterized in that the medical X-ray device arrangement comprises means ~~(15)~~ for modelling the object ~~(4)~~ mathematically by assuming that the X-ray imaging geometry, such as X-ray source position, has unknown error modelled in the distribution $p(m|x)$.

Claim 31 (currently amended): A medical X-ray device ~~(5)~~ arrangement according to claim 19, characterized in that the medical X-ray device arrangement comprises means ~~(15)~~ for modelling the object ~~(4)~~ mathematically by assuming that X-radiation measurement noise is Poisson distributed.

Claim 32 (currently amended): A medical X-ray device ~~(5)~~ arrangement according to claim 19, characterized in that the medical X-ray imaging is dental radiography.

Claim 33 (currently amended): A medical X-ray device ~~(5)~~ arrangement according to claim 19, characterized in that the medical X-ray imaging is surgical C-arm imaging.

Claim 34 (currently amended): A medical X-ray device ~~(5)~~ arrangement according to claim 19, characterized in that the medical X-ray imaging is mammography.

Claim 35 (currently amended): A medical X-ray device ~~(5)~~ arrangement according to claim 19, characterized in that the medical X-ray device arrangement comprises means ~~(15)~~ for producing

three-dimensional information of the object ~~(4)~~ on the basis of the maximum a posteriori estimator (MAP), which is calculated by the equation:

$$p(x_{\mathrm{MAP}} \mid m) = \max p(x \mid m),$$

m representing projection data and x representing the object image vector and where the maximum on the right hand side of the equation is taken over all x.

Claim 36 (currently amended): A medical X-ray device ~~(5)~~ arrangement according to claim 19, characterized in that the medical X-ray device arrangement comprises means ~~(15)~~ for producing three-dimensional information of the object ~~(4)~~ on the basis of the conditional mean estimator (CM), which is calculated by the equation

$$x_{\mathrm{CM}} = \int x\, p(x \mid m)\, dx$$

where m represents projection data and x represents the object image vector.